## REMARKS

Claims 1-30 are all the claims presently pending in the application. Claims 1, 7, 14-16, and 22 are amended to more clearly define the invention. Claims 8-13 and 29-30 are withdrawn from consideration. Of the remaining claims, claims 1, 14-16, and 22 are independent.

These amendments are made only to more particularly point out the invention for the Examiner and not for narrowing the scope of the claims or for any reason related to a statutory requirement for patentability.

Applicant also notes that, notwithstanding any claim amendments herein or later during prosecution, Applicant's intent is to encompass equivalents of all claim elements.

Claims 1, 3-5, 16, 18-19, 22, and 24-26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the O'Neil et al. reference in view of the Gulutzan et al. reference. Claims 2, 7, 17, 21, 23, and 28 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the O'Neil et al. reference in view of the Gulutzan et al. reference and further in view of the Dietz reference. Claims 6, 20, and 27 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over the O'Neil et al. reference in view of the Abiteboul et al. reference. Claim 14 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the Wang et al. reference in view of the Rastogi et al. reference. Claim 15 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over the Wang et al. reference in view of the Abiteboul et al. reference.

These rejections are respectfully traversed in the following discussion.

## I. THE CLAIMED INVENTION

A first exemplary embodiment of the claimed invention is directed to a method of maintaining the order of nodes in a hierarchical document. The method includes selecting a first parameter corresponding to a selected maximum number of children for each node for an auxiliary ordered tree, selecting a second parameter corresponding to a selected minimum number of children for each node of the auxiliary ordered tree, building the auxiliary ordered tree having at least as many leaves as atoms within the hierarchical document based upon the first and second parameters, attaching the atoms to the leaves of the auxiliary ordered tree, labeling each of the nodes in the auxiliary ordered tree, and communicating the labeled nodes of the

auxiliary ordered tree to a user. The labels include integer numbers having a size that is bounded by the first parameter and the second parameter.

Conventional methods for representing an XML document using a tree diagram assign ordered labels to data items by checking interval containment of the labels. However, these conventional labeling schemes have very poor performance when there is an update to the XML document. Conventional methods typically sequentially assign labels in sequential order which requires substantial re-labeling of the entire tree for every change.

An alternative conventional method for labeling an XML document tree may leave gaps between successive labels. However, these gaps are often times filled as additional nodes are inserted into the XML tree.

In stark contrast, an exemplary embodiment of the present invention provides labels that include integer number having a size that is bounded by a first parameter that corresponds to a selected maximum number children and a second parameter that corresponds to a selected minimum number of children for each node in the auxiliary ordered tree. In this manner, gaps may be dynamically assigned and maintained to ensure optimal use of the auxiliary ordered tree.

## II. THE 35 U.S.C. § 112, FIRST PARAGRAPH REJECTION

The Examiner alleges that claims 1 and 14-15 are not enabled by the specification.

With respect to claim 1, the Examiner alleges that the "specification does not provide enough information to enable person (sic) skilled in the art being able (sic) to correspond the first/second parameter to the maximum/minimum number of children in each node."

Applicants respectfully submit that, contrary to the Examiner's allegation, the specification provide a more than enabling disclosure. The specification very clearly explains and, indeed, provides multiple examples, of first and second parameters, how these parameters correspond to the maximum/minimum number of children and, further, what factors are useful in selecting these parameters. The Examiner is requested to review the specification at, for example, page 11, line 6 – page 24, line 13.

In particular, the specification very clearly explains that there "are two exemplary parameters, f and s, for the label tree, which may be selected and which may determine the shape

of the tree." (page 11, lines 6 – 7). "For any node x in the label tree, an exemplary embodiment of the invention selects values for f and s (as explained later)." (page 11, lines 10-11). "We can infer the meaning of parameters f and s from the splitting algorithm explained above, where f defines the maximum fanout of the label tree, and s determines the number of sub-trees created after a split. The inventors call this factor the "split factor." Both of these parameters contribute to the shape of the tree. An exemplary method for assigning values to f and s will be described below."

Therefore, contrary to the Examiner's allegations, one of ordinary skill in the art is clearly enabled such that one of ordinary skill in the art is clearly able to correspond the first/second parameters to the maximum/minimum number of children in each node.

With respect to claim 14, the Examiner alleges that the "specification does not provide enough information to enable person (sic) skilled in the art being able (sic) to 'optimizing an auxiliary ordered tree' based on 'adjusting the maximum. . . ' and 'the selected minimum . . .'"

The Examiner further clarifies the Examiner's confusion by alleging that "it is unclear that 'optimizing' means to optimize tree size/level or update/total cost." In this regard, this amendment amends claim 14 to further clarify this aspect of the present invention in accordance with Examiner Lin's very helpful suggestion.

The Examiner also alleges that "selecting maximum/minimum number of children based on the application requirements of the size of the labels is not disclosed in the specification."

However, contrary to the Examiner's allegation the specification very clearly explains that "Given an expected final size n of an XML document, parameters f and s may be set according to different application needs to optimize the constant factors of the cost and bits." (page 17, lines 29-31). The specification very clearly illustrates how to minimize cost at, for example, page 17, line 32 – page 20, line 2 and illustrates how to minimize overall cost at, for example, page 20, lines 4 – 22.

More particularly, the specification very clearly relates the selection of these parameters to the number of bits which are required to encode labels at, for example, page 19, lines 15 – 22). One of ordinary skill in the art understands that the number of bits that are required to encode a label is proportional to the size of the label.

With respect to claim 15, the Examiner alleges that the "specification does not provide enough information to enable person (sic) skilled in the art being able (sic) to encode auxiliary ordered tree based on the maximum/minimum number of children for each node and using a virtual tree to minimize the space requirements."

The Examiner clarifies the Examiner's confusion by alleging that "it is unclear what 'minimizing space requirements' refers to (sic)" and that "Applicant does not disclose how to (sic) 'minimizing space requirements using a virtual tree.'"

Applicants respectfully submit that those of ordinary skill in the art understand that the reference to minimizing space requirements refers to minimizing the space requirements for implementation of the invention. Those of ordinary skill in the art obviously understand that certain applications and/or hardware restrictions may limit the space which is available to the user and, thus, it may be very valuable to minimize the space requirements for the invention. The specification very clearly describes why minimizing space requirements may be important at, for example, page 16, lines 20 – 26).

Further, the specification clearly explains how these space requirements may be minimized using a virtual tree as explained above at, for example, page 16, line 27 – page 20, line 15).

In view of the foregoing, the Examiner is respectfully requested to withdraw this rejection.

## III. THE 35 U.S.C. § 112, SECOND PARAGRAPH REJECTION

The Examiner alleges that claim 7 is indefinite. While Applicant submits that such would be clear to one of ordinary skill in the art to allow them to know the metes and bounds of the invention, taking the present Application as a whole, to speed prosecution claim 7 has been amended in accordance with Examiner Lin's very helpful suggestions.

In view of the foregoing, the Examiner is respectfully requested to withdraw this rejection.

## IV. THE PRIOR ART REJECTIONS

### A. The O'Neil et al. reference in view of the Gulutzan et al. reference

Regarding claims 1, 3-5, 16, 18-19, 22, and 24-26, the Examiner alleges that the Gulutzan et al. reference would have been combined with the O'Neil et al. reference to form the claimed invention. Applicants submit, however, that these references would not have been combined and, even if combined, the combination would not teach or suggest each and every element of the claimed invention.

None of the applied references teaches or suggests the features of the claimed invention as recited by, for example, independent claim 1, including labels that include integer number having a size that is bounded by a first parameter that corresponds to a selected maximum number children and a second parameter that corresponds to a selected minimum number of children for each node in the auxiliary ordered tree. As explained above, this is important for dynamically assigning and maintaining gaps to ensure optimal use of an auxiliary ordered tree.

The O'Neil et al. reference describes a labeling scheme for storing hierarchical data (e.g., XML data) in a relational database, such that subsequent updates are possible without re-labeling the existing nodes. However, the labeling scheme that is disclosed by the O'Neil et al. reference is hierarchical in nature. In other words, the label of each node contains as a prefix the label of all its ancestors.

In stark contrast, the present invention provides a labeling scheme that relies upon integer numbers of bounded size.

The labeling scheme of the O'Neil et al. reference employs labels of unbounded length in order to avoid re-labeling, the inventive labeling scheme guarantees that the size of the labels is logarithmic in the size of the document.

The O'Neil et al. reference very clearly does not teach or suggest labels that include integer number having a size that is bounded by a first parameter that corresponds to a selected maximum number children and a second parameter that corresponds to a selected minimum number of children for each node in the auxiliary ordered tree.

The Gulutzan et al. reference does not remedy the deficiencies of the O'Neil et al. reference.

The Gulutzan et al. reference discloses characteristics of B-Trees, a data structure that is widely used in commercial database management systems for improving the performance of database queries. While a B-Tree may be used for improving the performance of access to any labeling scheme for hierarchical data, there is no evidence that by using B-Trees in conjunction with the labeling scheme that is disclosed by the O'Neil et al. reference, that one of ordinary skill in the art would obtain the method recited by the claimed invention.

Indeed, the nature of the labels described by the O'Neil et al. reference is completely different than the claimed invention. The labels disclosed by the O'Neil et al. reference are hierarchical in nature while the labels of the claimed invention are numerical in nature.

Therefore, the Examiner is respectfully requested to withdraw the rejection of claims 1, 3-5, 16, 18-19, 22, and 24-26.

**B. The O'Neil et al. reference in view of the Gulutzan et al. reference and further in view of the Dietz reference**

Regarding claims 2, 7, 17, 21, 23, and 28, the Examiner alleges that the Gulutzan et al. reference would have been combined with the O'Neil et al. reference and further alleges that the Dietz reference would have been combined with the Gulutzan et al. reference and the O'Neil et al. reference to form the claimed invention. Applicants submit, however, that these references would not have been combined and, even if combined, the combination would not teach or suggest each and every element of the claimed invention.

None of the applied references teaches or suggests the features of the claimed invention as recited by, for example, independent claim 1, including labels that include integer number having a size that is bounded by a first parameter that corresponds to a selected maximum number children and a second parameter that corresponds to a selected minimum number of children for each node in the auxiliary ordered tree. These features are important for dynamically assigning and maintaining gaps to ensure optimal use of an auxiliary ordered tree.

As explained above, neither of the O'Neil et al. reference nor the Gulutzan et al. reference teaches or suggest these features.

The Dietz reference does not remedy the deficiencies of the O'Neil et al. reference and

the Gulutzan et al. reference.

The Dietz reference discloses a labeling scheme for maintaining the order of nodes in a linked list by using an auxiliary tree data structure for assigning the numerical labels to nodes in such a way as to allow for subsequent insertions into the list while incurring an amortized update cost that is logarithmic in the size of the list.

In stark contrast, an exemplary embodiment of the present invention provides: 1) a labeling scheme for maintaining the order of nodes in a hierarchical document (e.g., XML) as opposed to a linear linked list; 2) a tree data structure that has an adjustable number of children per node as opposed to a tree data structure which is a 2-3 tree (i.e. a tree where each node has either 2 or 3 children); and 3) a method for optimizing the parameters that determines the shape of the auxiliary tree.

Clearly, the Dietz reference does not teach or suggest labels that include integer number having a size that is bounded by a first parameter that corresponds to a selected maximum number children and a second parameter that corresponds to a selected minimum number of children for each node in the auxiliary ordered tree.

Further, one of ordinary skill in the art would not have formed the claimed invention by combining the disclosure in the Dietz reference with the method disclosed by the O'Neil et al. reference or the B-tree description in the Gulutzan et al. reference.

Therefore, the Examiner is respectfully requested to withdraw the rejection of claims 2, 7, 17, 21, 23, and 28.

**C. The O'Neil et al. reference in view of the Gulutzan et al. reference and further in view of the Abiteboul et al. reference**

Regarding claims 6, 20, and 27, the Examiner alleges that the Gulutzan et al. reference would have been combined with the O'Neil et al. reference and further alleges that the Abiteboul et al. reference would have been combined with the Gulutzan et al. reference and the O'Neil et al. reference to form the claimed invention. Applicants submit, however, that these references would not have been combined and, even if combined, the combination would not teach or suggest each and every element of the claimed invention.

None of the applied references teaches or suggests the features of the claimed invention as recited by, for example, independent claim 1, including labels that include integer number having a size that is bounded by a first parameter that corresponds to a selected maximum number children and a second parameter that corresponds to a selected minimum number of children for each node in the auxiliary ordered tree. These features are important for dynamically assigning and maintaining gaps to ensure optimal use of an auxiliary ordered tree.

As explained above, neither of the O'Neil et al. reference nor the Gulutzan et al. reference teaches or suggest these features.

The Abiteboul et al. reference does not remedy the deficiencies of the O'Neil et al. reference and the Gulutzan et al. reference.

Rather, the Abiteboul et al. reference discloses a labeling scheme for hierarchical documents that enables the efficient execution of ancestor queries. This labeling scheme is different from the claimed invention because the labeling scheme is not based on an auxiliary tree data structure and it has no provision for efficient re-labeling in the case of insertions. Since, the Abiteboul et al. reference is not relevant to an auxiliary tree data structure, clearly the Abiteboul et al. reference does not teach or suggest labels that include integer number having a size that is bounded by a first parameter that corresponds to a selected maximum number children and a second parameter that corresponds to a selected minimum number of children for each node in the auxiliary ordered tree.

Further, one of ordinary skill in the art would not have formed the claimed invention by combining the disclosure in the Abiteboul et al. reference with the method disclosed by the O'Neil et al. reference or the B-tree description in the Gulutzan et al. reference.

Therefore, the Examiner is respectfully requested to withdraw the rejection of claims 6, 20, and 27.

### D. The Wang et al. reference in view of the Rastogi et al. reference

Regarding claim 14, the Examiner alleges that the Rastogi et al. reference would have been combined with the Wang et al. reference to form the claimed invention. Applicants submit, however, that these references would not have been combined and, even if combined, the

combination would not teach or suggest each and every element of the claimed invention.

None of the applied references teaches or suggests the features of the claimed invention as recited by, for example, independent claim 14, including nodes of an auxiliary ordered tree having numerical labels according to a recursive formula and the leaves in a label tree correspond to the nodes in a corresponding XML tree in pre-order traversal. As explained above, these features are important for dynamically assigning and maintaining gaps to ensure optimal use of an auxiliary ordered tree.

The Wang et al. reference discloses a method for encoding of hierarchical documents based on suffix trees which have a different structure than the claimed auxiliary ordered trees. This tree structure that is disclosed by the Wang et al. reference, an example of which is illustrated in Figure 3, is represented as a structure-encoded sequence as follows:

(P; ε); (S; P); (N; PS); (v1; PSN); (I;PS); (M; PSI); (v2; PSIM); (N; PSI); (v3; PSIN); (I;PSI); (M; PSII); (v4; PSIIM); (I; PS); (N; PSI); (v5; PSIN); (L; PS); (v6; PSL); (B;P); (L; PB); (v7; PBL); (N; PB); (v8; PBN)

In the above sequence, each node in the original XML tree is represented as a pair (*nodeID*, *path*) where *nodeID* is a node identifier and *path* is a string obtained by concatenating the node identifiers from the root down to the node. The v1 … v8 denote numbers obtained by applying a hash function h to the string values present in the leaves of the XML tree: v1= h("dell"), v2=h("ibm"), …, v8= h("panasia").

This structure-encoded sequence representation is used for compactly storing multiple XML document trees in what is known as *suffix trees*, a tree which embodies a compact index to all the distinct, contiguous substrings of a given string.

Figure 5 in the Wang et al. reference provides an example of two sequences for two XML documents and their encoding in a suffix tree.

Figure 5 of the Wang et al. reference shows an example of using a suffix-tree-like structure to index structure-encoded sequences for non-contiguous matching. We insert two sequences, Doc1 and Doc2, into the suffix tree. Originally, the elements in the sequences represent nodes in the XML document trees, from which the sequences are derived. Now, they also represent nodes in the suffix tree. Since the nodes are involved in two different trees, two

kinds of ancestor-descendant relationships among the sequence elements arise: i) D-Ancestorship: the ancestor-descendant relationships of the nodes that they represent in the original XML document tree, and ii) S-Ancestorship: the ancestor-descendant relationships of the nodes that they represent in the suffix tree. For instance, element (S; P) is a D-ancestor of (L; S) and element (v1; PSN) is an S-Ancestor of (L; PS).

The nodes in the suffix trees of the Wang et al. reference are further indexed using $B^{+}$Trees as shown in the figure 6.

It should be apparent that both the suffix trees in the Wang et al. reference have a completely different structure (and purpose) than the auxiliary ordered tree in accordance with the claimed invention an example of which is illustrated in Figure 6B of the present application.

The suffix trees in the Wang et al. reference have nodes which contain pairs (nodeID, path) and are organized by common substrings among a collection of XML trees. Further, the $B^{+}$Trees are index structures that maintain the order of nodes in the suffix tree.

In stark contrast, an auxiliary ordered tree in accordance with an exemplary embodiment of the invention has nodes labeled with numerical labels according to a recursive formula and the leaves in the label tree correspond to the nodes in the original XML tree in pre-order traversal.

Clearly, the Wang et al. reference does not teach or suggest nodes of an auxiliary ordered tree having numerical labels according to a recursive formula and the leaves in a label tree correspond to the nodes in a corresponding XML tree in pre-order traversal.

The Rastogi et al. reference does not remedy the deficiencies of the Wang et al. reference.

Rather, the Rastogi et al. reference discloses a method for building, in a top-down fashion, a decision tree classifier that employs an optimization heuristic based on minimizing the cost of sub-trees rooted at nodes that have not been expanded yet. This type of tree has a completely different purpose and structure than the auxiliary ordered tree of the present invention.

The trees described by the Rastogi et al. reference are *decision trees*. One example of such a decision tree is given in the figure 2 of the Rastogi et al. reference. It should be clear that this tree is different from the claimed auxiliary ordered tree since it includes nodes encoding questions as internal nodes and actions as leaf nodes (nothing to do with XML and numerical

labels).

Further, one of ordinary skill in the art would not have formed the claimed invention by combining the disclosure in the Rastogi et al. reference with the method disclosed by the Wang et al. reference.

Therefore, the Examiner is respectfully requested to withdraw the rejection of claim 14.

**E. The Wang et al. reference in view of the Abiteboul et al. reference**

Regarding claim 15, the Examiner alleges that the Rastogi et al. reference would have been combined with the Wang et al. reference to form the claimed invention. Applicants submit, however, that these references would not have been combined and, even if combined, the combination would not teach or suggest each and every element of the claimed invention.

None of the applied references teaches or suggests the features of the claimed invention as recited by, for example, independent claim 14, including <u>nodes of an auxiliary ordered tree having numerical labels according to a recursive formula and the leaves in a label tree correspond to the nodes in a corresponding XML tree in pre-order traversal</u>. These features are important for dynamically assigning and maintaining gaps to ensure optimal use of an auxiliary ordered tree.

As explained above, the Wang et al. reference very clearly does not teach or suggest these features.

The Abiteboul et al. reference does not remedy the deficiencies of the Wang et al. reference.

Rather, the Abiteboul et al. reference discloses a labeling scheme for hierarchical documents that enables the efficient execution of ancestor queries. This labeling scheme is different from the claimed invention because the labeling scheme is not based on an auxiliary tree data structure and it has no provision for efficient re-labeling in the case of insertions.

The XML labeling method described by the Abiteboul et al. reference does not employ an auxiliary tree structure. So it should be clear that it is a different labeling scheme from the claimed invention. Their labeling algorithm is described in the figure on page 8 of the Abiteboul et al. reference.

Clearly, the Abiteboul et al. reference does not teach or suggest nodes of an auxiliary ordered tree having numerical labels according to a recursive formula and the leaves in a label tree correspond to the nodes in a corresponding XML tree in pre-order traversal.

Further, one of ordinary skill in the art would not have formed the claimed invention by combining the disclosure in the Abiteboul et al. reference with the method disclosed by the Wang et al. reference.

Therefore, the Examiner is respectfully requested to withdraw the rejection of claim 15.

## V. FORMAL MATTERS AND CONCLUSION

In view of the foregoing amendments and remarks, Applicants respectfully submit that claims 1-30, all the claims presently pending in the Application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the Application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Assignee's Deposit Account No. 50-0510.

Respectfully Submitted,

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James E. Howard
Registration No. 39,715

**McGinn Intellectual Property Law Group, PLLC**
8321 Old Courthouse Rd., Suite 200
Vienna, Virginia 22182
(703) 761-4100
**Customer No. 48150**